

Operations Research, Spring 2024 (112-2)

Pre-lecture Problems for Lecture 4: Nonlinear Programming

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Note. The deadline of submitting the pre-lecture problem is **9:30 AM, March 11**. Please submit a hard copy of your work in class. Late submissions will not be accepted. Each student must submit her/his individual work. Submit **ONLY** the problem that counts for grades.

1. (0 point) Mary uses chemicals 1 and 2 to produce two drugs. Drug 1 must be at least 60% chemical 1. For example, blending 11 oz of chemical 1 and 9 makes there only $\frac{11}{11+9} = 55\%$ of chemical 1, which does not make the produced drug 1 of the required quality. For drug 2, there must be at least 50% chemical 2. Up to 100 oz of drug 1 can be sold at \$6 per oz; up to 90 oz of drug 2 can be sold at \$5 per oz. Up to 130 oz of chemical 1 can be purchased at \$6 per oz, and up to 80 oz of chemical 2 can be purchased at \$4 per oz. Formulate an LP that can be used to maximize Mary's profits.
2. (0 point) Linearize the following program

$$\begin{aligned} \max \quad & 5 \min\{x_1, x_2\} + 3x_2 \\ \text{s.t.} \quad & \max\{x_1, x_2\} \leq 16 \\ & x_1 + 4x_2 \leq 20 \\ & x_2 \geq 8 \\ & x_1 \geq 0, x_2 \geq 0. \end{aligned}$$

3. (10 points) A firm is considering importing some products to sell in a local market. The unit price and cost for product i are p_i and C_i , respectively. While the prices may be determined by the firm, the costs are given and fixed. For product i , the demand volume is $A_i - B_i p_i$, where A_i and B_i are all given. The fixed cost of importing product i is K_i . In other words, the cost K_i is incurred if and only if a positive amount of product i is imported. Note that given the existence of the fixed cost, to maximize the firm's profit it may be good to import only a subset of products. Formulate a mathematical program that can find a purchasing plan that maximizes the firm's profit. Determine whether your program is a linear program, a linear integer program, a nonlinear program, or a nonlinear integer program.